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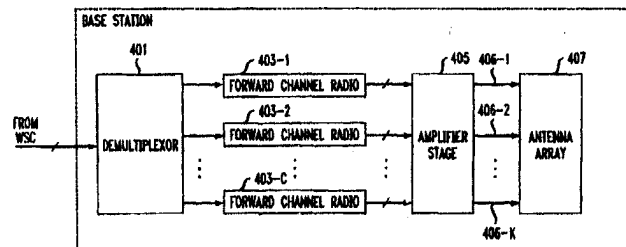
(54) **A multi-carrier CDMA transmission system with frequency and space diversity**

(57) A wideband CDMA transmission system is disclosed that incorporates transmit diversity in both frequency and space. Some embodiments of the present invention are capable of transmitting a wideband signal with a high data rate to an appropriately-designed wideband CDMA wireless terminal and are also capable of transmitting a narrowband (e.g., IS-95 compliant) signal to a CDMA wireless terminal in the prior art. Some embodiments of the present invention are capable of co-existing in the same frequency spectrum that is allocated to existing narrowband wireless systems. And in some embodiments of the present invention the coded symbols from the interleaver are distributed among multiple carriers that are then radiated by spatially separated antennas.

An illustrative method of the present invention comprises: receiving a datastream of symbols that is to be transmitted to one wireless terminal; distributing at least some of the datastream of symbols to a first derivative datastream of symbols; distributing at least some of the datastream of symbols to a second derivative datastream of symbols; modulating the first derivative datastream of symbols onto a first carrier frequency to create a first modulated carrier; modulating the second derivative datastream of symbols onto a second carrier frequency that is different than the first carrier frequency to create a second modulated carrier; radiating the first modulated carrier from a first antenna; and radiating the second modulated carrier from a second antenna that is separated from the first antenna.

**FIG. 4**

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# EUROPEAN SEARCH REPORT

Application Number  
EP 99 30 0047

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.8)
X	US 5 652 764 A (KANZAKI KIYOKO ET AL) 29 July 1997 (1997-07-29) * abstract * * column 2, line 12-22 * * column 7, line 15-36 * * figure 10 *	1-4,8-11	H04B7/06 H04B7/12
X	WO 97 49199 A (ERICSSON TELEFON AB L M) 24 December 1997 (1997-12-24) * abstract * * page 15, line 14,15 * * page 17, line 16 - page 19, line 10 * * figures 4,6 *	1,5-8, 12,13	
X	SAKAKURA S ET AL: "PRE-DIVERSITY USING CODING, MULTI-CARRIERS AND MULTI-ANTENNAS" 1995 FOURTH IEEE INTERNATIONAL CONFERENCE ON UNIVERSAL PERSONAL COMMUNICATIONS RECORD. GATEWAY TO THE 21ST. CENTURY. TOKYO, NOV. 6 - 10, 1995, IEEE INTERNATIONAL CONFERENCE ON UNIVERSAL PERSONAL COMMUNICATIONS, NEW YORK, IEEE, US, vol. CONF. 4, 6 November 1995 (1995-11-06), pages 605-609, XP000690023 ISBN: 0-7803-2955-4 * abstract * * page 606, left-hand column, paragraph 3; figure 1A *	1,6-8,13	TECHNICAL FIELDS SEARCHED (Int.Cl.8) H04B
A	US 5 289 499 A (WEERACKODY VIJITHA) 22 February 1994 (1994-02-22) * abstract *	1-13	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 15 October 2001	Examiner Helms, J
CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document		T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons &: member of the same patent family, corresponding document	

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Application Number  
EP 99 30 0047

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	<p>BAN K ET AL: "CONVOLUTIONALLY CODED DS/SSMA SYSTEM USING MULTI-ANTENNA TRANSMISSION"</p> <p>IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE. PHOENIX, ARIZONA, NOV. 3 - 8, 1997, GLOBAL TELECOMMUNICATIONS CONFERENCE (GLOBECOM), NEW YORK, IEEE, US, vol. 1, 3 November 1997 (1997-11-03), pages 92-96, XP000737518</p> <p>ISBN: 0-7803-4199-6</p> <p>* abstract *</p> <p>-----</p>	1-13	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			
Place of search <b>MUNICH</b>		Date of completion of the search <b>15 October 2001</b>	Examiner <b>Helms, J</b>
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>T : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons</p> <p>&amp; : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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15-10-2001

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5652764	A	29-07-1997	JP 8195703 A	30-07-1996
			CN 1138252 A	18-12-1996
			GB 2297224 A , B	24-07-1996
WO 9749199	A	24-12-1997	US 6006075 A	21-12-1999
			US 6243565 B1	05-06-2001
			AU 3280797 A	07-01-1998
			CN 1227683 A	01-09-1999
			EP 0906670 A2	07-04-1999
			JP 2000513163 T	03-10-2000
			WO 9749199 A2	24-12-1997
			US 6212242 B1	03-04-2001
US 5289499	A	22-02-1994	CA 2109789 A1	30-06-1994
			EP 0605119 A2	06-07-1994
			JP 2780918 B2	30-07-1998
			JP 6303214 A	28-10-1994
			US 5394435 A	28-02-1995

EPO FORM P0439

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82